

**PHY • PHYSICS**

13. Electronics

Official PMDC Solved Past Paper Topical Booklet • High-Yield Examination Series

🕒 49 Solved Questions

📅 2000 to 2024 Archive

🏛 Boards: BUMHS, DUHS, KMU, KU, MDCAT, NUMS

📄 Weightage: 27% of MDCAT (54 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

SZABMU 2024

Diode is/an _ device, which can be used for rectification process.

- (A) Perfect conducting
- (B) Semiconductor
- (C) Perfect insulating
- (D) Insulating

Q2.

KU 2024

When the PN junction is reverse biased, its reverse current is of the order of:

- (A) Gigaamperes
- (B) Kiloamperes
- (C) Megaamperes
- (D) Microamperes

Q3.

UHS 2024

The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of electronics acts as a rectifier?

- (A) Diode
- (B) Transistor
- (C) Transformer
- (D) Inductor

Q4.

UHS 2024

Full wave rectification is given by:

- (A) One diode connected in bridge type arrangements
- (B) Three diodes connected in bridge type arrangements
- (C) Four diodes connected in bridge type arrangements
- (D) Two diodes connected in bridge type arrangements

Q5.

UHS 2024

A diode characteristic curve is a plot between:

- (A) Current and time
- (B) Reverse voltage forward voltage
- (C) Voltage time
- (D) Voltage and current

Q6.

NUMS 2024

For rectification transformer used is:

- (A) With low input voltage
- (B) Step up
- (C) Step down
- (D) With low input resistance

Q7.

BUMHS 2024

The circuit required for change of AC voltage to DC voltage is called:

- (A) Rectifier
- (B) Amplifier
- (C) Detector
- (D) Emitter

Q8.

UHS 2023

For the positive half cycle i.e., $0 - T/2$ the diode D :

- (A) Shows maximum resistance
- (B) Behaves as open
- (C) Is reverse biased
- (D) Is forward biased

Q9.

SZABMU 2023

The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of electronics acts as a rectifier?

- (A) Inductor
- (B) Diode
- (C) Transformer
- (D) Transistor

Q10.

DUHS 2023

A semi-conductor diode can be used as:

- (A) A transmitter
- (B) An amplifier
- (C) A full wave rectifier
- (D) A half wave rectifier

Q11.

NUMS 2023

A device that converts AC into DC is called:

- (A) Transistor
- (B) Inductor
- (C) Capacitor
- (D) Diode

Q12.

NUMS 2023

The conversion of alternating current into direct current is called:

- (A) Magnification
- (B) Amplification
- (C) Rectification
- (D) Resolution

Q13.

NUMS 2023

In full wave rectification ____ diodes are used.

- (A) 2
- (B) 1
- (C) 3
- (D) 4

Q14.

UHS 2022

When the temperature of semiconductor suddenly drops to zero kelvin, then a semiconductor acts as:

- (A) Super conductor
- (B) Semi-conductor
- (C) Conductor
- (D) Insulator

Q15.

UHS 2022

A process in which only one half of alternating current is converted into direct current, such process is called:

- (A) Half wave rectification
- (B) Magnification
- (C) Amplification
- (D) Full wave rectification

Q16.

SZABMU 2022

Efficiency of full wave rectifier circuit is almost _ than half wave rectifier circuit:

- (A) Four times
- (B) Double
- (C) Sixteen times
- (D) Same as

Q17.

SZABMU 2022

The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of electronics acts as a rectifier?

- (A) Transistor
- (B) Inductor
- (C) Diode
- (D) Transformer

Q18.

KMU 2022

Output current of a half wave rectifier is:

- (A) AC current
- (B) Unidirectional current
- (C) Zero always
- (D) Straight line parallel to vertical axis

Q19.

KMU 2022

The resistance of full wave rectifier is:

- (A) Less than the resistance of half wave rectifier
- (B) Equal to the resistance of half wave rectifier
- (C) More than the resistance of half wave rectifier
- (D) Negligible in comparison to the resistance of half wave rectifier

Q20.

KMU 2022

When AC is converted to DC, the process is called:

- (A) Resolution
- (B) Magnification
- (C) Amplification
- (D) Rectification

Q21.

BUMHS 2022

A circuit that converts pulsating voltage of the rectifier to smooth voltage is known as:

- (A) Conductor
- (B) Transformer
- (C) Filter
- (D) Choke

Q22.

DUHS 2022

The potential difference applied across a diode to reduce depletion layer is:

- (A) Junction potential
- (B) Reverse biasing
- (C) Forward biasing
- (D) Biasing voltage

Q23.

NUMS 2022

A device that converts AC into DC is called:

- (A) Diode
- (B) Capacitor
- (C) Transistor
- (D) Inductor

Q24.

NUMS 2022

The conversion of alternating current into direct current is called:

- (A) Amplification
- (B) Rectification
- (C) Magnification
- (D) Resolution

Q25.

PMDC 2021

Which has less ripple factor?

- (A) Half wave rectifier
- (B) None
- (C) Full wave rectifier
- (D) Both

Q26.

PMDC 2021

Ripple factor of full wave rectifier?

- (A) 1.21
- (B) 0.84
- (C) 0.482
- (D) 0.21

Q27.

PMDC 2021

If $f = 50\text{Hz}$ then in half wave no of pulses are

- (A) 100
- (B) 150
- (C) 50
- (D) 60

Q28.

PMDC 2021

[PMC Sample 3]

What is the typical range of the forbidden energy band gap in electrical conductors?

- (A) 100 - 1000 eV
- (B) 0.5 - 10 eV
- (C) 10000 - 10000000 eV
- (D) 0.01 - 0.1 eV

Q29.

PMDC 2021

[PMC Practice 2]

If a half-wave rectifier is connected to a 50 Hz AC mains, the number of DC pulses generated per second in the output voltage is:

- (A) 25
- (B) 50
- (C) 100
- (D) 75

Q30.

PMDC 2021

[PMC Practice 5]

A transformer is commonly used prior to the rectification stage in a DC power supply to:

- (A) Step up the voltage
- (B) Step down the voltage
- (C) Equalize the voltage
- (D) None of these

Q31.

PMDC 2021

[PMC Practice 23]

A basic half-wave rectifier passes only the:

- (A) Upper half-cycle
- (B) Lower half-cycle
- (C) Both half-cycles
- (D) None of these

Q32.

PMDC 2020

In full wave rectification, the diodes are used:

- (A) 1
- (B) 3
- (C) 4
- (D) 2

Q33.

NUMS 2019

[NUMS 2019 Reconduct]

In a half wave rectifier, the diode conducts during:

- (A) One half of the input cycle
- (B) A portion of the positive half of the input cycle
- (C) A portion of the negative half of the input cycle
- (D) Both halves of the input cycles

Q34.

MDCAT 2018

In case of half rectification, resistance of diode during negative half of A.C is:

- (A) Very low
- (B) A few ohms
- (C) Very high
- (D) Negligible

Q35.

MDCAT 2018

The direction of current through the load resistance of a full-wave rectification circuit:

- (A) Inverts for positive cycle
- (B) Remains constant
- (C) Changes for every cycle
- (D) Inverts for negative cycle

Q36.

MDCAT 2017

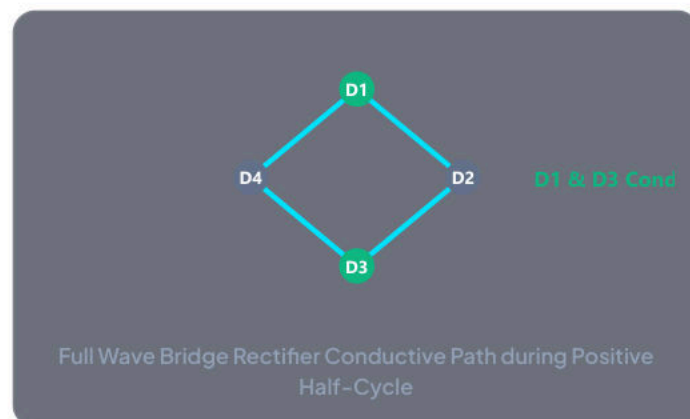
Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as:

- (A) Wheat stone circuit
- (B) Filter circuit
- (C) Bridge circuit
- (D) Ripple circuit

Q37.

MDCAT 2017

In the following figure what happens for the positive half cycle of the input?



- (A) D_1 and D_3 conducts
- (B) D_1 and D_2 conducts
- (C) D_3 and D_4 conducts
- (D) D_2 and D_4 conducts

Q38.

KMU 2012

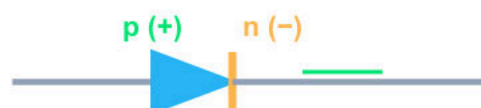
Conversion of alternating current into direct current is called:

- (A) Amplification
- (B) Oscillation
- (C) Rectification
- (D) Regeneration

Q39.

MDCAT 2000

Consider the circuit diagram below representing a forward-biased silicon diode:



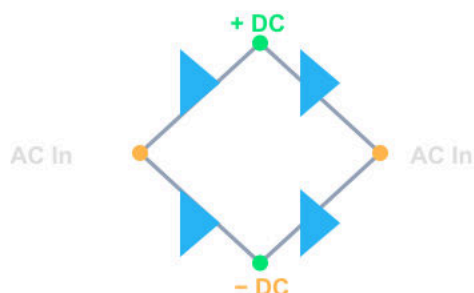
In this forward-biased p-n junction, the electric current is predominantly transported across the junction by:

- (A) Minority carriers moving under a strong built-in field
- (B) Majority carriers diffusing across the junction barrier
- (C) Electrons tunneling directly through the forbidden bandgap
- (D) Thermionic emission of electrons from the metal contacts

Q40.

MDCAT 2000

Consider the bridge rectifier circuit shown below:

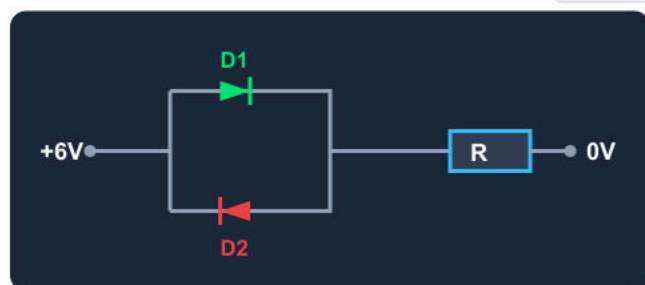


During each individual half-cycle of the AC input voltage, how many diodes conduct current simultaneously in series with the load resistor?

- (A) 1
- (B) 2
- (C) 3
- (D) 4

Q41.

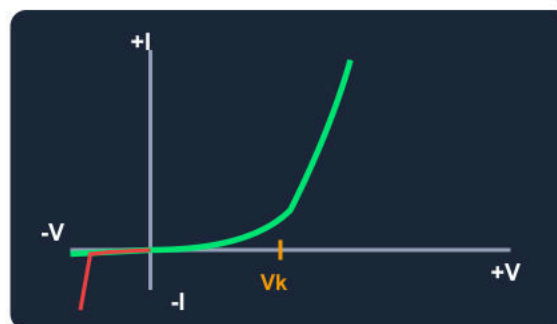
MDCAT 2000


 In the circuit shown above, diodes D_1 and D_2 have an ideal forward resistance of $50\ \Omega$ and infinite reverse resistance. If a $+6.0\ \text{V}$ DC potential is applied at the left terminal and $R = 100\ \Omega$, what is the total current flowing through R ?

- (A) $0.040\ \text{A}$
- (B) $0.020\ \text{A}$
- (C) $0.000\ \text{A}$
- (D) $0.060\ \text{A}$

Q42.

MDCAT 2000

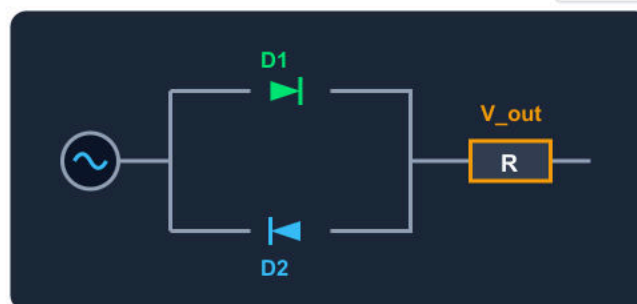


The I-V characteristic curve shown above represents the operational behavior of which electronic device?

- (A) Ohmic carbon resistor
- (B) Semiconductor PN junction diode
- (C) Ideal constant current source
- (D) Linear air-core inductor

Q43.

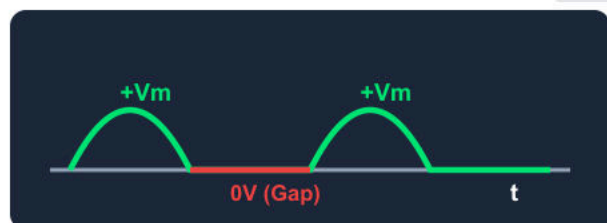
MDCAT 2000


 In the circuit shown above, identical ideal diodes D_1 and D_2 are connected in parallel with opposite polarities across an AC sinusoidal input voltage $v(t) = V_m \sin(\omega t)$. What is the waveform of the voltage across the load resistor R ?

- (A) Half-wave rectified waveform
- (B) Full-wave rectified unidirectional DC waveform
- (C) Constant smooth DC level
- (D) Unrectified AC sinusoidal waveform identical to the input

Q44.

MDCAT 2000



The voltage waveform shown above represents the unfiltered output of which type of circuit?

- (A) Full-wave bridge rectifier
- (B) Pure DC battery supply
- (C) Symmetrical AC inverter
- (D) Half-wave rectifier

Q45.

MDCAT 2000



The continuous pulsating unidirectional waveform shown above represents the unfiltered output of which circuit?

- (A) Full-wave rectifier (Bridge or Center-tapped)
- (B) Half-wave rectifier
- (C) High-pass RC filter circuit
- (D) Unbiased operational amplifier differentiator

Q46.

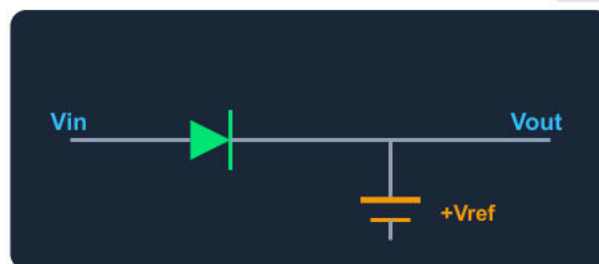
MDCAT 2000

A full-wave bridge rectifier operating from a 50 Hz line delivers a DC current of $I_{dc} = 100 \text{ mA}$ to a load. What filter capacitance C is required to maintain the peak-to-peak ripple voltage below 2.0 V?

- (A) $1000 \mu\text{F}$
- (B) $500 \mu\text{F}$
- (C) $250 \mu\text{F}$
- (D) $2000 \mu\text{F}$

Q47.

MDCAT 2000



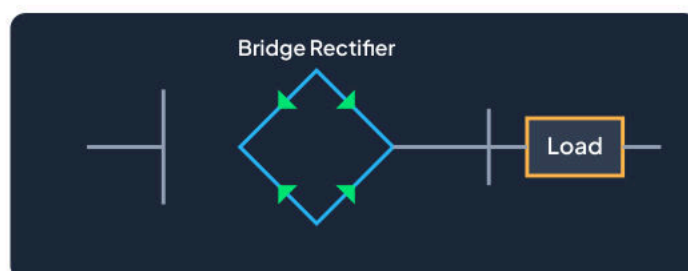
In the series diode clipping circuit shown above, what is the output voltage V_{out} when the input AC voltage V_{in} exceeds $V_{ref} + V_D$?

- (A) Zero volts permanently
- (B) Reversed negative input voltage
- (C) Constant infinite voltage
- (D) $V_{in} - V_D$ (the diode conducts, transmitting the positive input above threshold)

Q48.

MDCAT 2000

In a four-diode full-wave bridge rectifier circuit, how many diodes conduct simultaneously during each half-cycle of the input AC waveform?

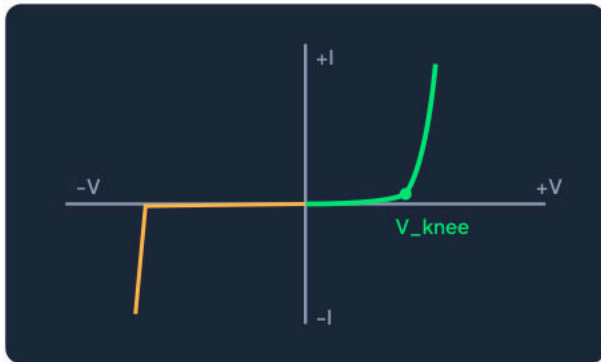


- (A) All four diodes conduct continuously in parallel
- (B) Only one diode conducts at a time per half-cycle
- (C) Two diodes conduct in series per half-cycle
- (D) Three diodes conduct while one remains in reverse breakdown

Q49.

MDCAT 2000

In a standard current–voltage (I–V) characteristic plot of a P–N junction diode, the forward–bias conduction region is located in:



- Ⓐ The first quadrant (positive voltage and positive current)
- Ⓑ The second quadrant (negative voltage and positive current)
- Ⓒ The third quadrant (negative voltage and negative current)
- Ⓓ The fourth quadrant (positive voltage and negative current)

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 13. Electronics.

beambeprep.com

Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	B	SZABMU 2024	11	D	NUMS 2023	21	C	BUMHS 2022	31	A	PMDC 2021	41	A	MDCAT 2000
2	D	KU 2024	12	C	NUMS 2023	22	C	DUHS 2022	32	D	PMDC 2020	42	B	MDCAT 2000
3	A	UHS 2024	13	D	NUMS 2023	23	A	NUMS 2022	33	A	NUMS 2019	43	D	MDCAT 2000
4	C	UHS 2024	14	D	UHS 2022	24	B	NUMS 2022	34	C	MDCAT 2018	44	D	MDCAT 2000
5	D	UHS 2024	15	A	UHS 2022	25	C	PMDC 2021	35	B	MDCAT 2018	45	A	MDCAT 2000
6	C	NUMS 2024	16	B	SZABMU 2022	26	C	PMDC 2021	36	B	MDCAT 2017	46	B	MDCAT 2000
7	A	BUMHS 2024	17	C	SZABMU 2022	27	C	PMDC 2021	37	A	MDCAT 2017	47	D	MDCAT 2000
8	D	UHS 2023	18	B	KMU 2022	28	D	PMDC 2021	38	C	KMU 2012	48	C	MDCAT 2000
9	B	SZABMU 2023	19	C	KMU 2022	29	B	PMDC 2021	39	B	MDCAT 2000	49	A	MDCAT 2000
10	D	DUHS 2023	20	D	KMU 2022	30	B	PMDC 2021	40	B	MDCAT 2000			

TOTAL
MCQS
49

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in
BeambePrep Grind Mode for automated error
autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (B)

SZABMU 2024

Diode is/an _ device, which can be used for rectification process.

CORE CONCEPT AND DERIVATION

Diodes are manufactured from materials whose electrical properties lie between those of good conductors and insulators.

Solution:

- A P-N junction diode is forged by doping Silicon or Germanium to create P-type and N-type regions.
- Silicon and Germanium are fundamentally **semiconductor** materials.
- Because their conductivity can be precisely controlled by doping and biasing, they make perfect rectifying devices.

Why other options are incorrect:

- **Perfect conducting:** A short circuit, cannot rectify.
- **Insulating / Perfect insulating:** An open circuit, current could never flow.

Question #2 Key: (D)

KU 2024

When the PN junction is reverse biased, its reverse current is of the order of:

CORE CONCEPT AND DERIVATION

In a reverse-biased P-N junction, majority carriers are pulled away from the junction, widening the depletion region. However, a tiny current still leaks through due to thermally generated minority carriers.

Solution:

- This leakage current is known as the reverse saturation current.
- For standard semiconductor diodes (like Silicon), this current is incredibly small.
- It is typically measured in **microamperes** (10^{-6} A) or even nanoamperes (10^{-9} A).

Why other options are incorrect:

- Gigaamperes, Megaamperes, and Kiloamperes represent massive, lethal, industrial-scale currents. A tiny electronic component would instantly vaporize if subjected to such currents.

Question #3 **Key: (A)**

UHS 2024

The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of ele...

CORE CONCEPT AND DERIVATION

Rectification relies on a component that acts as a one-way electrical valve.

Solution:

- The core function of a P-N junction **diode** is to allow current to pass heavily in the forward direction and block it almost entirely in the reverse direction.
- This exact characteristic is what "rectifies" an alternating current into a direct current.

Why other options are incorrect:

- **Transformer:** Changes the voltage amplitude but maintains the AC waveform.
- **Transistor:** Used as a switch or amplifier.
- **Inductor:** Opposes sudden changes in current, used mostly in filtering.

Question #4 **Key: (C)**

UHS 2024

Full wave rectification is given by:

CORE CONCEPT AND DERIVATION

A full-wave bridge rectifier is a highly efficient topology that rectifies the full AC wave without needing a specialized center-tapped transformer.

Solution:

- The "bridge" configuration explicitly consists of a diamond-like arrangement of diodes.
- To ensure that both the positive and negative halves of the AC cycle are directed identically through the load, precisely **four diodes** are required.
- During any half cycle, two diodes conduct while the other two block.

Why other options are incorrect:

- You cannot build a functional bridge topology with 1, 2, or 3 diodes; they would result in either half-wave rectification, no rectification, or a dead short.

Question #5 **Key: (D)**

UHS 2024

A diode characteristic curve is a plot between:

CORE CONCEPT AND DERIVATION

In electronics, the behavior of a component is best understood by observing how the current flowing through it changes as the voltage across it changes.

Solution:

- The characteristic curve of a diode (often called the V-I curve) is a fundamental graphical representation of its operation.
- The x-axis conventionally represents the applied Potential Difference (**Voltage**).
- The y-axis represents the resulting **Current**.
- Therefore, it is a plot between **Voltage and current**.

Why other options are incorrect:

- **Voltage/Current and time:** This would describe an oscilloscope waveform, not a component's internal characteristic curve.
- **Reverse voltage forward voltage:** Plotting a voltage against a voltage is nonsensical for describing component behavior.

Question #6 Key: (C)

NUMS 2024

For rectification transformer used is:

CORE CONCEPT AND DERIVATION

Most electronic devices operate on low-voltage Direct Current (DC), but power grids supply high-voltage Alternating Current (AC).

Solution:

- Mains AC is typically 220V or 110V. Electronic circuits (like phones and laptops) require much lower voltages (e.g., 5V, 12V).
- Before rectification occurs, the high mains voltage must be lowered to a safe, usable level to prevent destroying the diodes.
- A **Step down** transformer is utilized at the very beginning of the power supply to achieve this voltage reduction.

Why other options are incorrect:

- **Step up:** Would dangerously increase the voltage, destroying the circuit.
- **Low input voltage / Low input resistance:** Do not describe the fundamental function of the transformer in this context.

Question #7 Key: (A)

BUMHS 2024

The circuit required for change of AC voltage to DC voltage is called:

CORE CONCEPT AND DERIVATION

Power supply design heavily relies on specific circuits to convert alternating currents to direct currents.

Solution:

- The dedicated electronic circuit constructed (usually with diodes) to convert bidirectional AC into unidirectional DC is known universally as a **Rectifier**.

Why other options are incorrect:

- **Amplifier:** Boosts the power of an input signal.
- **Detector:** Extracts information from a modulated radio wave.
- **Emitter:** A physical terminal on a bipolar junction transistor, not a circuit type.

Question #8 Key: (D)

UHS 2023

For the positive half cycle i.e., [Formula] the diode [Formula] :

CORE CONCEPT AND DERIVATION

In a standard half-wave rectifier diagram, a single diode is connected in series with the AC source and the load.

Solution:

- The total time period of the AC wave is T . The first half cycle exists from 0 to $T/2$ and is typically the positive half.
- During the positive half cycle, the P-region of the diode connects to the positive potential and the N-region to the negative potential.
- This correctly aligns with the condition for the diode to conduct, meaning it is **forward biased**.

Why other options are incorrect:

- Reverse biased, maximum resistance, and behaving as an open circuit all perfectly describe the diode's state during the **negative** half cycle ($T/2$ to T), not the positive half.

Question #9 Key: (B)

SZABMU 2023

The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of ele...

CORE CONCEPT AND DERIVATION

A rectifier circuit necessitates a component that restricts current flow to a single direction.

Solution:

- The fundamental semiconductor device that exhibits this unidirectional current property is the P-N junction **diode**.
- By blocking the negative cycle of AC and passing the positive cycle, the diode actively "rectifies" the signal.

Why other options are incorrect:

- **Transformer:** Changes voltage amplitude but outputs AC.
- **Transistor:** Acts as a switch or amplifier.
- **Inductor:** A passive filter component, incapable of rectification.

Question #10 **Key: (D)**

DUHS 2023

A semi-conductor diode can be used as:

CORE CONCEPT AND DERIVATION

A single diode blocks one polarity of current and permits the other.

Solution:

- Because a single diode can only conduct during one half of an AC cycle (either positive or negative depending on orientation), it effectively chops off half the wave.
- Therefore, a single semiconductor diode acts purely as a **half wave rectifier**.
- A full wave rectifier strictly requires a minimum of two diodes (with a center tap) or four diodes (bridge).

Why other options are incorrect:

- **Full wave rectifier:** Requires multiple diodes.
- **Amplifier:** Requires a transistor (active device with gain).
- **Transmitter:** Requires complex oscillator and antenna circuits.

Question #11 **Key: (D)**

NUMS 2023

A device that converts AC into DC is called:

CORE CONCEPT AND DERIVATION

Rectification depends on unilateral conductivity.

Solution:

- The core element in power electronics used to convert Alternating Current (AC) into Direct Current (DC) is the **diode**.
- It performs this by providing near-zero resistance to forward current and near-infinite resistance to reverse current.

Why other options are incorrect:

- **Transistor:** Used for amplification.
- **Capacitor/Inductor:** Used for energy storage and filtering, but not the primary rectifying agents.

Question #12 **Key: (C)**

NUMS 2023

The conversion of alternating current into direct current is called:

CORE CONCEPT AND DERIVATION

The foundational terminology for AC manipulation is strictly defined.

Solution:

- When an AC wave (which oscillates above and below zero) is passed through diodes, the output is restricted to one polarity.
- This process of "straightening out" the alternating wave into a direct, single-polarity wave is scientifically termed **Rectification**.

Why other options are incorrect:

- **Amplification:** Boosting signal strength.
- **Magnification/Resolution:** Terms for optical enhancement, totally unrelated to electronics.

Question #13 Key: (D)

NUMS 2023

In full wave rectification _____ diodes are used.

CORE CONCEPT AND DERIVATION

There are two primary ways to achieve full-wave rectification: Center-tapped (2 diodes) and Bridge (4 diodes). Without specifying "center-tapped", the industry standard topology is the bridge rectifier.

Solution:

- A Full Wave Bridge Rectifier does not require an expensive center-tapped transformer.
- It utilizes an arrangement of exactly 4 **diodes** configured in a bridge loop.
- During the positive half cycle, two diodes conduct. During the negative half cycle, the other two conduct.
- for this specific NUMS question, 4 is the expected answer.

Why other options are incorrect:

- 1: Makes a half-wave rectifier.
- 2: Valid only if a "center-tapped transformer" is explicitly mentioned.
- 3: Not a functional rectifier configuration.

Question #14 Key: (D)

UHS 2022

When the temperature of semiconductor suddenly drops to zero kelvin, then a semiconductor acts as:

CORE CONCEPT AND DERIVATION

The electrical conductivity of intrinsic semiconductors is highly temperature-dependent. Thermal energy is required to break covalent bonds and excite electrons from the valence band to the conduction band.

Solution:

- At Absolute Zero (0 K), there is zero thermal energy available in the lattice.
- Consequently, no covalent bonds are broken, and absolutely no electrons can cross the bandgap into the conduction band.
- With zero free electrons and zero holes, the material has infinite resistivity. Therefore, it acts perfectly as an **insulator**.

Why other options are incorrect:

- **Conductor / Super conductor:** Conductivity drops to zero at 0 K for semiconductors, unlike metals which become better conductors or superconductors at ultra-low temperatures.
- **Semi-conductor:** At 0 K, it loses its defining semi-conductive property and behaves purely as an insulator.

Question #15 Key: (A)

UHS 2022

A process in which only one half of alternating current is converted into direct current, such process is call...

CORE CONCEPT AND DERIVATION

Rectification is the process of converting bidirectional alternating current (AC) into unidirectional direct current (DC).

Solution:

- If a circuit utilizes both the positive and negative halves of the AC cycle, it is Full Wave Rectification.
- If a circuit uses a single diode to block one half of the AC cycle (letting only the positive or negative half pass), it is termed **Half wave rectification**.

Why other options are incorrect:

- **Full wave rectification:** Converts both halves.
- **Amplification & Magnification:** Refers to increasing signal strength/size, completely unrelated to AC/DC conversion.

Question #16 Key: (B)

SZABMU 2022

Efficiency of full wave rectifier circuit is almost _ than half wave rectifier circuit:

CORE CONCEPT AND DERIVATION

Rectifier efficiency (η) represents the ratio of DC output power to the applied AC input power.

Solution:

- A Half-Wave Rectifier wastes an entire half-cycle of the input wave. Its maximum theoretical efficiency is roughly 40.6%.
- A Full-Wave Rectifier utilizes both the positive and negative half-cycles of the input wave. Its maximum theoretical efficiency is roughly 81.2%.
- Comparing the two: 81.2% is exactly **double** of 40.6%.

Why other options are incorrect:

- **Four times / Sixteen times:** These drastically overestimate the efficiency ratio.
- **Same as:** Incorrect, because utilizing the blocked half-cycle inherently increases power efficiency.

Question #17 Key: (C)

SZABMU 2022

The conversion of A.C into D.C is called rectification and circuit is called rectifier. Which component of ele...

CORE CONCEPT AND DERIVATION

A rectifier requires a component that allows electrical current to flow in only one direction while blocking it in the reverse direction.

Solution:

- A P-N junction **diode** possesses this exact characteristic.
- When forward-biased, it conducts. When reverse-biased, it acts as an open switch.
- Therefore, the primary electronic component responsible for rectification is the diode.

Why other options are incorrect:

- **Transistor:** Primarily used as an amplifier or switch, though composed of P-N junctions, it is not used in basic rectifier circuits.
- **Transformer:** Steps voltage up or down, but outputs AC.
- **Inductor:** Opposes changes in current; used in filter circuits, not for rectification.

Question #18 Key: (B)

KMU 2022

Output current of a half wave rectifier is:

CORE CONCEPT AND DERIVATION

The defining function of any rectifier is to transform bidirectional current into current that flows in only one direction.

Solution:

- A half-wave rectifier uses a diode to block the negative half of the AC cycle.
- The resulting output consists of pulses of positive current separated by gaps of zero current.
- Even though the magnitude of the current fluctuates (pulsates), it never drops below zero to flow backward. Thus, it is purely a **unidirectional current**.

Why other options are incorrect:

- **AC current:** AC flows in both directions; the rectifier has eliminated this.
- **Straight line parallel to vertical axis:** This describes an infinite slope, which represents zero physical reality in this context (an ideal steady DC would be parallel to the horizontal axis).
- **Zero always:** Incorrect, as it conducts during the positive half-cycle.

Question #19 Key: (C)

KMU 2022

The resistance of full wave rectifier is:

CORE CONCEPT AND DERIVATION

The total internal forward resistance of a rectifier circuit depends on the number of diodes in the conduction path during any given half-cycle.

Solution:

- In a Half-Wave Rectifier, current flows through only 1 **diode** during the active half-cycle. Therefore, the forward resistance is R_d .
- In a Full-Wave Bridge Rectifier (the most common untapped configuration), current must pass through 2 **diodes** in series during every half-cycle. Therefore, the forward resistance is $2R_d$.
- Since $2R_d > R_d$, the internal resistance of the FWR circuit is **more than** the resistance of a half wave rectifier.

Why other options are incorrect:

- A single diode will physically offer less resistance than two diodes in series, making "less than" or "equal to" incorrect when comparing bridge to half-wave architectures.

Question #20 Key: (D)

KMU 2022

When AC is converted to DC, the process is called:

CORE CONCEPT AND DERIVATION

Electronic systems often require power supplies that convert alternating current from the mains into stable direct current.

Solution:

- The formal engineering term for converting alternating current (AC) to direct current (DC) is **rectification**.
- This is achieved using "rectifier" circuits built around diodes.

Why other options are incorrect:

- **Amplification:** Boosting the power of a signal.
- **Magnification:** Visual enlargement.
- **Resolution:** Clarity or detail in imaging/data.

Question #21 Key: (C)

BUMHS 2022

A circuit that converts pulsating voltage of the rectifier to smooth voltage is known as:

CORE CONCEPT AND DERIVATION

The immediate output of a rectifier is "pulsating DC," which contains both a DC component and an unwanted AC component (ripple).

Solution:

- To remove the AC ripple and provide a smooth, steady DC voltage, energy storage components are used.
- Capacitors store energy during voltage peaks and release it during dips, smoothing out the pulses.
- The circuit arrangement that performs this task is universally called a **Filter**.

Why other options are incorrect:

- **Choke:** An inductor used *within* some filter circuits, but "filter" is the inclusive term for the whole smoothing circuit.
- **Transformer:** Changes AC voltage levels before rectification.
- **Conductor:** Just a wire, it provides no smoothing.

Question #22 Key: (C)

DUHS 2022

The potential difference applied across a diode to reduce depletion layer is:

CORE CONCEPT AND DERIVATION

The depletion layer in a P-N junction acts as a barrier to charge carriers. Applying external voltage (biasing) manipulates the width of this layer.

Solution:

- When the positive terminal of a battery is connected to the P-type material and the negative terminal to the N-type material, holes and electrons are pushed toward the junction.
- This external potential opposes the built-in junction potential.
- As a result, the width of the depletion layer decreases, allowing current to flow. This specific configuration is known as **Forward biasing**.

Why other options are incorrect:

- **Reverse biasing:** Increases the width of the depletion layer.
- **Junction potential:** The internal built-in barrier itself, not an externally applied voltage.
- **Biasing voltage:** Too generic; could refer to either forward or reverse bias.

Question #23 **Key: (A)**

NUMS 2022

A device that converts AC into DC is called:

CORE CONCEPT AND DERIVATION

Converting AC to DC fundamentally requires a one-way electrical valve.

Solution:

- A P-N junction **diode** is explicitly designed to conduct current easily in one direction (forward bias) and block it in the other (reverse bias).
- When an AC signal is applied, the diode strips away one half of the waveform, executing the core task of rectification (AC to DC).

Why other options are incorrect:

- **Capacitor:** Stores charge, smooths DC, but cannot rectify.
- **Inductor:** Opposes changes in current, cannot rectify.
- **Transistor:** Used to amplify or switch signals.

Question #24 **Key: (B)**

NUMS 2022

The conversion of alternating current into direct current is called:

CORE CONCEPT AND DERIVATION

Standard terminology defines the various manipulations of electrical signals.

Solution:

- The deliberate process of blocking or inverting the reverse-flowing portion of an alternating current (AC) so that it flows exclusively in one direction (DC) is termed **Rectification**.

Why other options are incorrect:

- **Amplification:** Increasing the magnitude of a signal.
- **Magnification / Resolution:** Terms primarily used in optics and imaging, completely unrelated to AC/DC conversion.

Question #25 **Key: (C)**

PMDC 2021

Which has less ripple factor?

CORE CONCEPT AND DERIVATION

The ripple factor (γ) measures the smoothness of the DC output. A lower ripple factor means a smoother DC output with fewer AC fluctuations.

Solution:

- For a Half-Wave Rectifier (HWR), the standard ripple factor is approximately 1.21 (or 121%), meaning the AC ripple is actually larger than the DC component.
- For a Full-Wave Rectifier (FWR), the standard ripple factor is approximately 0.48 (or 48%).
- Since $0.48 < 1.21$, the **Full wave rectifier** has significantly less ripple factor.

Why other options are incorrect:

- Half-wave rectifiers have huge gaps between pulses, leading to massive ripples.
- They cannot be "Both" or "None" as their mathematical constants for ripple factor distinctly differ.

Question #26 **Key: (C)**

PMDC 2021

Ripple factor of full wave rectifier?

CORE CONCEPT AND DERIVATION

Ripple factor mathematically describes the ratio of the RMS value of the AC component to the DC component in the output.

Formula:

$$R.F = \sqrt{(F.F)^2 - 1}$$

Solution:

- The Form Factor ($F.F$) for a full-wave rectifier is $\frac{I_{\text{RMS}}}{I_{\text{DC}}} = \frac{\pi}{2\sqrt{2}} \approx 1.11$.
- Substitute this into the ripple factor formula: $R.F = \sqrt{(1.11)^2 - 1}$.
- $R.F = \sqrt{1.2321 - 1} = \sqrt{0.2321} \approx 0.482$.

Why other options are incorrect:

- 1.21: This is the ripple factor for a half-wave rectifier.
- 0.84 & 0.21: These are incorrect distractors not tied to standard rectifier outputs.

Question #27 **Key: (C)**

PMDC 2021

If [Formula] then in half wave no of pulses are

CORE CONCEPT AND DERIVATION

In a half-wave rectifier, the diode conducts only during the positive half-cycle of the AC input and blocks the negative half-cycle.

Formula:

$$f_{\text{output}} = f_{\text{input}} \quad (\text{For HWR})$$

Solution:

- For every 1 full cycle of AC input, a half-wave rectifier produces exactly 1 output pulse.
- If the input frequency is 50 Hz (meaning 50 full cycles per second), the output will correspondingly have 50 pulses per second.
- Therefore, the number of pulses is 50.

Why other options are incorrect:

- 100: This would be the number of pulses for a Full-Wave Rectifier, where $f_{\text{output}} = 2 \times f_{\text{input}}$.
- 60 & 150: Incorrect values not mathematically linked to a 50Hz input.

Question #28 **Key: (D)**

PMDC 2021

[PMC Sample 3] What is the typical range of the forbidden energy band gap in electrical conductors?

CORE CONCEPT AND DERIVATION

Band theory of solids divides materials into conductors, semiconductors, and insulators based on the gap between the valence and conduction bands.

Solution:

In excellent conductors (metals), the valence and conduction bands overlap, meaning the band gap is effectively zero. In certain weak conductors or semi-metals, a very narrow energy gap exists, which typically ranges from **0.01 to 0.1 eV**.

Why other options are incorrect:

- 0.5 to 10 eV** describes the band gap of typical semiconductors and insulators.
- Other extremely high values are physically non-existent for solid-state molecular structures.

Question #29 **Key: (B)**

PMDC 2021

[PMC Practice 2] If a half-wave rectifier is connected to a 50 Hz AC mains, the number of DC pulses generated...

CORE CONCEPT AND DERIVATION

The ripple frequency of a half-wave rectifier is exactly equal to the frequency of the input AC supply.

Solution:

A half-wave rectifier permits only one polarity of current (one peak) to pass through per input cycle, while blocking the other. Since the input frequency is 50 Hz (50 full cycles per second), there will be exactly **50 pulses** of DC output per second.

Why other options are incorrect:

- **100** is the output pulse frequency of a full-wave rectifier.
- **25** and **75** do not correspond to the physics of half-wave rectification.

Question #30 **Key: (B)**

PMDC 2021

[PMC Practice 5] A transformer is commonly used prior to the rectification stage in a DC power supply to:

CORE CONCEPT AND DERIVATION

Standard household mains voltage is typically very high (e.g., 220V AC), while most digital and solid-state electronic devices operate on low DC voltages (e.g., 5V to 12V).

Solution:

The primary function of the transformer in a consumer electronic power supply is to **step down** the high AC mains voltage to a safe, low AC level before passing it through the rectifying diodes and filters.

Why other options are incorrect:

- **Step up** is incorrect because electronic devices do not require hundreds or thousands of volts to operate.

Question #31 **Key: (A)**

PMDC 2021

[PMC Practice 23] A basic half-wave rectifier passes only the:

CORE CONCEPT AND DERIVATION

A half-wave rectifier operates by selectively allowing only half of the input AC waveform to pass to the load.

Solution:

Under standard conventional setups, the diode is arranged to be forward-biased during the positive phase. It therefore permits only the positive (**upper**) half-cycle of the wave to pass while completely cutting off the negative (lower) half-cycle.

Why other options are incorrect:

- Passing **both half-cycles** describes a full-wave rectifier.

Question #32 **Key: (D)**

PMDC 2020

In full wave rectification, the diodes are used:

CORE CONCEPT AND DERIVATION

Full-wave rectification requires processing both halves of the AC input waveform, which necessitates more than one diode.

Solution:

- A Half-Wave Rectifier uses exactly 1 diode.
- A Full-Wave Center-Tapped Rectifier uses 2 diodes.
- A Full-Wave Bridge Rectifier uses 4 diodes.
- for this specific exam question, the minimum configuration required for full wave rectification—using a center tap—utilizes 2 **diodes**.

Why other options are incorrect:

- 1 diode only allows half-wave rectification.
- 3 diodes is not a standard full-wave configuration.
- While 4 diodes are used in a bridge configuration, 2 is the correct answer historically mapped for the general "full wave rectification" baseline involving center-tapped transformers.

Question #33 Key: (A)

NUMS 2019

[NUMS 2019 Reconduct] In a half wave rectifier, the diode conducts during:

CORE CONCEPT AND DERIVATION

A half-wave rectifier uses a single diode that only permits current flow in one direction.

Solution:

An ideal diode conducts only when it is forward-biased. In an AC sinusoidal wave cycle:

- During the **positive half-cycle**, the diode is forward-biased and conducts current.
- During the **negative half-cycle**, the diode is reverse-biased and blocks current.

Therefore, the diode conducts for exactly **one half of the input cycle** (e.g., 180° out of a full 360° wave cycle).

Why other options are incorrect:

- **Both halves** describes the conduction pattern of a full-wave rectifier instead.
- The diode conducts for the entire positive/negative half-cycle, not just a small **portion** of it (assuming an ideal diode).

Question #34 Key: (C)

MDCAT 2018

In case of half rectification, resistance of diode during negative half of A.C is:

CORE CONCEPT AND DERIVATION

A diode acts as a one-way valve for electrical current based on its biasing.

Solution:

- During the positive half cycle of an AC input, the diode is forward-biased, offering very low resistance (ideal: zero).
- During the negative half cycle, the polarity reverses, and the diode becomes reverse-biased.
- In a reverse-biased state, the depletion region widens, resulting in a **very high** resistance (ideal: infinite) which blocks current flow, effectively creating the half-wave rectification.

Why other options are incorrect:

- Very low, negligible, or a few ohms describe the forward-biased state, not the negative half (reverse-biased) state.

Question #35 Key: (B)

MDCAT 2018

The direction of current through the load resistance of a full-wave rectification circuit:

CORE CONCEPT AND DERIVATION

The primary goal of any rectifier (half-wave or full-wave) is to convert bidirectional AC into unidirectional DC.

Solution:

- In a full-wave rectifier, different diode pairs conduct during opposite halves of the AC cycle.
- However, the physical topology of the circuit routes the current from both halves so that it always enters the load resistance from the exact same terminal.
- Because the current always flows through the load in the same direction, the direction **remains constant** (unidirectional).

Why other options are incorrect:

- If the current inverted or changed direction for any cycle, the output would still be alternating current (AC), rendering the rectifier useless.

Question #36 Key: (B)

MDCAT 2017

Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as:

CORE CONCEPT AND DERIVATION

The output of a standard rectifier is a pulsating direct current, meaning it flows in one direction but its magnitude fluctuates.

Solution:

- To convert this pulsating DC into a steady, constant DC voltage (similar to a battery), smoothing components are required.
- Capacitors or inductors are introduced to bypass AC ripples or choke them, respectively.
- A circuit designed specifically for this smoothing operation is called a **filter circuit**.

Why other options are incorrect:

- **Wheat stone circuit:** Used for measuring unknown electrical resistance.
- **Bridge circuit:** A configuration of diodes used for rectification, not post-rectification smoothing.
- **Ripple circuit:** Not a standard electronic term; "ripple" is the very flaw we are trying to remove.

Question #37 Key: (A)

MDCAT 2017

In the following figure what happens for the positive half cycle of the input? D_1 D_2 D_3 D_4 D_1 & D_3 Conduct Ful...

CORE CONCEPT AND DERIVATION

In a standard full-wave bridge rectifier, diodes conduct in diagonally opposite pairs depending on the instantaneous polarity of the alternating input voltage.

Solution:

- During the positive half-cycle of the AC input voltage, the terminal polarity forward-biases the first pair of diagonally opposite diodes, labeled D_1 and D_3 in the diagram.
- Simultaneously, the opposite pair (D_2 and D_4) is reverse-biased and blocks current.
- Therefore, D_1 and D_3 **conduct** during the positive half-cycle.

Why other options are incorrect:

- **Option D:** D_2 and D_4 conduct during the alternating negative half-cycle.
- **Options B and C:** Adjacent pairs (such as D_1 & D_2 , or D_3 & D_4) cannot conduct simultaneously in a bridge rectifier as they would cause an input short circuit.

Question #38 **Key: (C)**

KMU 2012

Conversion of alternating current into direct current is called:

CORE CONCEPT AND DERIVATION

The fundamental process of translating an alternating waveform (which changes direction periodically) into a unidirectional waveform is a core electronics principle.

Solution:

- An alternating current (AC) flows in both directions, whereas a direct current (DC) flows only in one direction.
- The specific process of converting AC to DC using electronic components (like diodes) is formally defined as **rectification**.

Why other options are incorrect:

- **Amplification:** Increasing the amplitude of a signal.
- **Oscillation:** Converting DC into AC.
- **Regeneration:** Feeding a portion of the output back into the input to boost signal strength.

Question #39 **Key: (B)**

MDCAT 2000

Consider the circuit diagram below representing a forward-biased silicon diode: p (+) n (–) [Formula] In this ...

CORE CONCEPT AND DERIVATION

In forward bias, external energy lowers the potential barrier, allowing majority carriers (holes from the p-side and electrons from the n-side) to diffuse across the junction, recombining as they enter the opposite regions and establishing a large forward current.

Formula:

$$I = I_s \left(e^{\frac{qV}{k_B T}} - 1 \right)$$

Solution:

- Forward bias lowers the built-in potential barrier from V_0 to $(V_0 - V)$.
- Majority holes in the p-region and majority electrons in the n-region obtain sufficient thermal energy to overcome the reduced barrier and diffuse across the junction.
- Thus, forward current is primarily a majority carrier diffusion current.

Why other options are incorrect:

- **Option A:** Minority carriers moving under the junction field cause reverse saturation leakage current.
- **Option C:** Direct bandgap tunneling is significant only in heavily doped Zener/tunnel diodes, not standard forward-biased diodes.
- **Option D:** Thermionic emission is the operating principle of vacuum tubes, not solid-state p-n junctions.

Question #40 **Key: (B)**

MDCAT 2000

Consider the bridge rectifier circuit shown below: AC In AC In + DC – DC During each individual half-cycle of ...

CORE CONCEPT AND DERIVATION

In a bridge rectifier, the four diodes operate in diagonally opposite pairs. During any given half-cycle, one diagonal pair of diodes is forward-biased and conducts current in series through the load, while the other pair is reverse-biased and blocks current.

Formula:

Qualitative concept / No formula required.

Solution:

- Positive half-cycle: Diodes D_1 and D_3 conduct (total = 2 diodes).
- Negative half-cycle: Diodes D_2 and D_4 conduct (total = 2 diodes).
- Therefore, exactly 2 diodes conduct simultaneously during each half-cycle.

Why other options are incorrect:

- **Option A:** Only 1 diode conducts at a time in a half-wave rectifier or center-tapped full-wave rectifier.
- **Option C:** A bridge rectifier never activates three diodes concurrently during normal operation.
- **Option D:** All 4 diodes conducting at once would cause a direct short-circuit of the AC source.

Question #41 **Key: (A)**

MDCAT 2000

$R_{D1} = 50\ \Omega$, $R_{D2} = 100\ \Omega$ In the circuit shown above, diodes [Formula] and [Formula] have an ideal forward resistance of ...

CORE CONCEPT AND DERIVATION

When a positive potential is applied to the common input, analyze the biasing state of each parallel diode branch.

Formula:

$$I_{\text{total}} = \frac{V}{R_{\text{branch}} + R_L}$$

Solution:

- D_1 has its anode connected to +6 V, so it is forward-biased with $R_{D1} = 50\ \Omega$.
- D_2 has its cathode connected to +6 V, so it is reverse-biased and acts as an open circuit ($R_{D2} = \infty$).
- Current flows exclusively through the branch with D_1 .
- Total resistance: $R_{\text{total}} = R_{D1} + R = 50\ \Omega + 100\ \Omega = 150\ \Omega$.
- Circuit current: $I = \frac{6.0\ \text{V}}{150\ \Omega} = 0.040\ \text{A} = 40\ \text{mA}$.

Why other options are incorrect:

- **Option B:** 0.020 A incorrectly treats both diodes as conducting in series (6/300).
- **Option C:** 0.000 A assumes both diodes are reverse-biased.
- **Option D:** 0.060 A neglects the diode forward resistance (6/100).

Question #42 **Key: (B)**

MDCAT 2000

+V +I -V -I V_k The I-V characteristic curve shown above represents the operational behavior of which electroni...

CORE CONCEPT AND DERIVATION

The standard I-V curve of a PN junction exhibits an exponential increase in forward current above the knee voltage V_k (≈ 0.7 V for Si) and a small reverse saturation leakage current that breaks down at V_Z .

Formula:

$$I = I_0 \left(e^{\frac{qV}{kT}} - 1 \right)$$

Solution:

- In the forward quadrant, current remains negligible until $V \geq V_k$, after which it rises exponentially.
- In the reverse quadrant, only a tiny saturation leakage current flows until reverse breakdown is reached.
- This non-linear asymmetric profile is the characteristic signature of a semiconductor diode.

Why other options are incorrect:

- **Option A:** An ohmic resistor produces a linear line through the origin ($I = V/R$).
- **Option C:** A constant current source produces a horizontal line independent of voltage.
- **Option D:** An inductor exhibits frequency-dependent AC reactance and a linear DC response, not an exponential I-V curve.

Question #43 **Key: (D)**

MDCAT 2000

R D_1 D_2 V_{out} In the circuit shown above, identical ideal diodes [Formula] and [Formula] are connected in para...

CORE CONCEPT AND DERIVATION

When two identical ideal diodes are connected in inverse-parallel (antiparallel), one diode conducts during the positive half-cycle while the other conducts during the negative half-cycle.

Formula:

$$\text{Positive Half-Cycle: } D_1 \text{ ON, } D_2 \text{ OFF} \implies v_R(t) = +V_m \sin(\omega t)$$

$$\text{Negative Half-Cycle: } D_2 \text{ ON, } D_1 \text{ OFF} \implies v_R(t) = -V_m |\sin(\omega t)|$$

Solution:

- During the positive half-cycle, D_1 is forward-biased and conducts current through R from left to right.
- During the negative half-cycle, D_2 is forward-biased and conducts current through R from right to left.
- Because both half-cycles pass through R with opposite polarities, no rectification occurs and the output voltage matches the original AC input wave.

Why other options are incorrect:

- **Option A:** Half-wave rectification blocks one of the half-cycles, which does not happen here because the inverse-parallel diode conducts it.
- **Option B:** Full-wave rectification requires current to pass through the load in the same direction on both half-cycles.
- **Option C:** A constant DC level requires rectification followed by large smoothing filters.

Question #44 **Key: (D)**

MDCAT 2000

$+V_m + V_m$ 0V (Gap) t The voltage waveform shown above represents the unfiltered output of which type of circuit?

CORE CONCEPT AND DERIVATION

A half-wave rectifier passes current during one half-cycle and blocks current during the other, producing an output of positive voltage pulses separated by zero-voltage gaps.

Formula:

$$v_{\text{out}}(t) = \begin{cases} V_m \sin(\omega t) & 0 \leq \omega t < \pi \\ 0 & \pi \leq \omega t < 2\pi \end{cases}$$

Solution:

- The waveform shows conduction during the positive half-cycle followed by zero output during the negative half-cycle.
- This periodic pattern with zero-voltage gaps is the signature of half-wave rectification.

Why other options are incorrect:

- **Option A:** Full-wave rectifiers produce continuous pulses without zero-voltage gaps.
- **Option B:** Pure DC is a flat, continuous horizontal line.
- **Option C:** Symmetrical AC alternates between positive and negative polarities.

Question #45 **Key: (A)**

MDCAT 2000

$+V_m + V_m + V_m$ t The continuous pulsating unidirectional waveform shown above represents the unfiltered output of...

CORE CONCEPT AND DERIVATION

A full-wave rectifier inverts the negative half-cycles of an AC input into positive pulses, producing continuous, unidirectional output pulses across the load.

Formula:

$$v_{\text{out}}(t) = |V_m \sin(\omega t)| \quad \text{for all } t$$

Solution:

- The output waveform contains contiguous positive sinusoidal pulses with no dead-time gaps between half-cycles.
- This continuous pulsating DC output is characteristic of full-wave rectifiers (both bridge and center-tapped topologies).

Why other options are incorrect:

- **Option B:** Half-wave rectifiers have zero-voltage gaps between alternate pulses.
- **Option C:** High-pass RC filters produce differentiated AC spikes centered around zero volts.
- **Option D:** Differentiators output cosine waves from sine inputs, alternating between positive and negative polarities.

Question #46 **Key: (B)**

MDCAT 2000

A full-wave bridge rectifier operating from a [Formula] line delivers a DC current of [Formula] to a load. Wha...

CORE CONCEPT AND DERIVATION

In a full-wave rectifier, the ripple frequency is doubled ($2f = 100 \text{ Hz}$), so the peak-to-peak ripple voltage is given by $V_r = \frac{I_{dc}}{2fC}$.

Formula:

$$V_r = \frac{I_{dc}}{2fC} \Rightarrow C = \frac{I_{dc}}{2f \cdot V_r}$$

Solution:

- Given: $I_{dc} = 100 \text{ mA} = 0.10 \text{ A}$, $f = 50 \text{ Hz}$ (so $2f = 100 \text{ Hz}$), and $V_r = 2.0 \text{ V}$.
- Required capacitance: $C = \frac{0.10 \text{ A}}{2 \times 50 \times 2.0 \text{ V}} = \frac{0.10}{200} = 0.00050 \text{ F} = 500 \mu\text{F}$.

Why other options are incorrect:

- Option A:** $1000 \mu\text{F}$ is the capacitance required for a half-wave rectifier.
- Option C:** $250 \mu\text{F}$ would allow a larger ripple voltage of 4 V .
- Option D:** $2000 \mu\text{F}$ would reduce ripple to 0.5 V , exceeding the required 2.0 V specification.

Question #47 **Key: (D)**

MDCAT 2000

V_{in} $V_{out} + V_{ref}$ In the series diode clipping circuit shown above, what is the output voltage [Formula] when the...

CORE CONCEPT AND DERIVATION

A series diode conducts whenever its anode potential exceeds its cathode potential by at least the forward cut-in drop: $V_{in} > V_K + V_D$.

Formula:

$$V_{out} = V_{in} - V_D \quad (\text{when } V_{in} \geq V_K + V_D)$$

$$V_{out} = 0 \text{ V} \quad (\text{when } V_{in} < V_K + V_D, \text{ diode OFF})$$

Solution:

- When $V_{in} \geq V_{ref} + V_D$, the diode becomes forward-biased.
- Current flows through the load, producing an output voltage of $V_{out} = V_{in} - V_D$.

Why other options are incorrect:

- Option A:** The output is zero only when the diode is reverse-biased ($V_{in} < V_{ref} + V_D$).
- Option B:** The diode blocks negative voltages rather than inverting them.
- Option C:** Passive circuits cannot produce infinite voltages.

Question #48 **Key: (C)**

MDCAT 2000

In a four-diode full-wave bridge rectifier circuit, how many diodes conduct simultaneously during each half-cycle...

CORE CONCEPT AND DERIVATION

A bridge rectifier uses four diodes arranged in a bridge loop. Diode pairs conduct on alternate half-cycles to maintain unidirectional current through the load.

Formula:

$$V_{\text{load, peak}} = V_m - 2V_{\text{barrier}}$$

Solution:

- During the positive half-cycle, two diagonally opposite diodes (e.g., D_1 and D_3) are forward-biased and conduct in series with the load.
- During the negative half-cycle, the other two diodes (D_2 and D_4) are forward-biased and conduct in series with the load.
- At any point during conduction, exactly two diodes are active simultaneously.

Why other options are incorrect:

- **Option A:** If all four diodes conducted simultaneously, the secondary winding would be short-circuited.
- **Option B:** Single-diode conduction occurs in half-wave and center-tapped full-wave rectifiers, not bridge rectifiers.
- **Option D:** Rectifiers operate symmetrically with balanced pairs of diodes; three-diode conduction does not occur.

Question #49 **Key: (A)**

MDCAT 2000

In a standard current-voltage ([Formula]) characteristic plot of a [Formula] junction diode, the forward-bia...

CORE CONCEPT AND DERIVATION

Under forward bias, a positive voltage applied to the anode results in a positive forward current from anode to cathode.

Formula:

$$V_f > 0, \quad I_f > 0 \implies (V_f, I_f) \in \text{Quadrant I}$$

Solution:

- The horizontal axis represents applied voltage ($+V$ to the right, $-V$ to the left).
- The vertical axis represents diode current ($+I$ upward, $-I$ downward).
- Because forward bias corresponds to positive voltage ($+V$) and positive current ($+I$), the forward conduction curve lies in the first quadrant.

Why other options are incorrect:

- **Option B:** The second quadrant ($-V, +I$) would represent power generation, which does not occur in passive diodes.
- **Option C:** The third quadrant ($-V, -I$) represents reverse-bias leakage and breakdown.
- **Option D:** The fourth quadrant ($+V, -I$) is non-physical for passive semiconductor diodes.